DISTRICT OF COLUMBIA
PUBLIC SCHOOLS
Office of the Chief Academic Officer

Summer 2010

Mathematics Summer Learning Packet

Grades 9-12

1200 First Street, NE | Washington, DC 20002 | T 202.442.5599 | F 202.442.5081 | www.dcps.dc.gov

Geometry and Architecture

Task: You will make a poster of a building or other structure in order to identify its various geometric shapes and properties. In addition, you will also write a 1-2 page paper of the building or structure.

Directions:

1. Make a list of any famous buildings or structures that you know or have researched. Based upon your list, identify one structure that interests you the most as a great example of geometric design. (Examples in D.C. could include the Washington Monument, the Capitol Building or even RFK Stadium.)

2. Find a picture or photograph of the building or structure you have chosen. There are a variety of resources that you can choose from, such as the internet, atlases, history books, geography books and magazines.

3. When examining your building or structure, identify, if possible, the following examples of geometry:
   - Parallel and perpendicular lines
   - Circles and semicircles
   - Polygons
   - Types of angles: acute, obtuse, and right
   - 3-dimensional shapes such as prisms, pyramids, cones, domes, and spheres
   - Symmetry including reflections, rotations, translations, and combinations

4. Draw your building or structure as accurately as you possibly can on poster paper. Your poster should have a title and all examples of geometric design should be neatly and properly labeled.

5. When writing your paper, be sure to include:
   - The history or background of the chosen building or structure
   - A summary of its geometric attributes
   - The designer and/or architect of the building or structure
   - The building's dimensions
   - The building's location
   - The present use of the building
   - Why you chose it for your Geometry of Architecture project

Examples of famous architecture around the world:
Pyramids of Giza (Egypt)
Parthenon (Athens)
Jefferson Memorial (Washington, DC)
Taj Mahal (India)

A Math Song

Task: You are to compose and perform a song that highlights a concept or fact in mathematics.

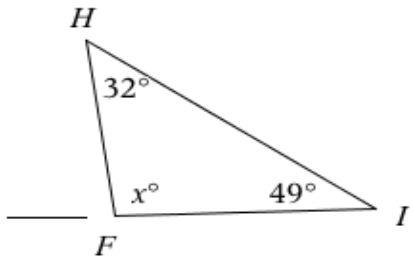
Directions:

1. Choose a math concept or fact that can be expressed in a song.
2. The song does not have to be long, but it should be creative and mathematically correct in rhyme.
3. Use a dictionary to help you write lyrics that rhyme.
4. Locate a song or write you own lyrics and background music for your presentation before family, friends or classmates.
5. If you are camera shy, you can tape record or videotape your song.

To The Rescue!

Solve the riddle: Find the missing angle measure in each triangle. When you have completed a problem, look at the blank lines on the next page. Write the letter of the angle on the line if any of the angle degrees of the letters match.

1.



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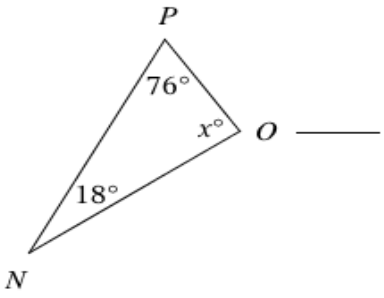

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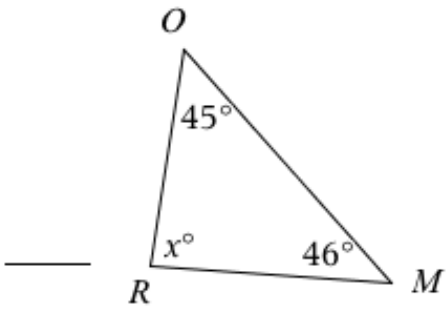

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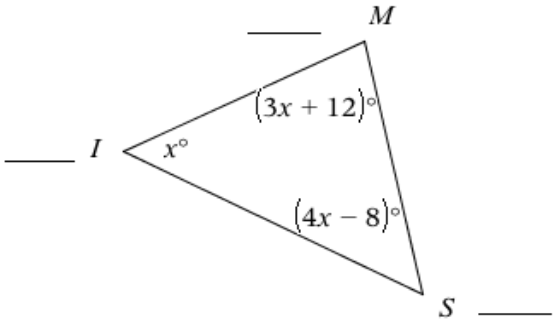

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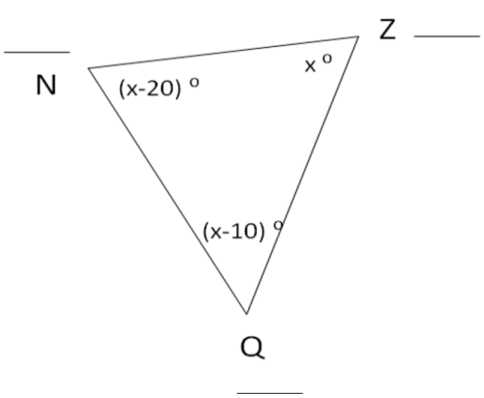
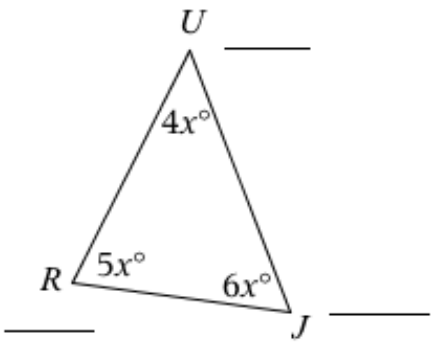
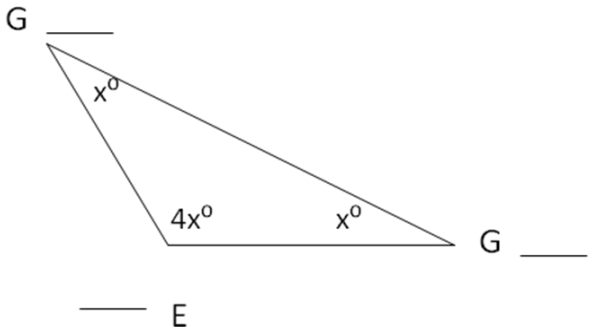




To The Rescue! (cont'd)

7.



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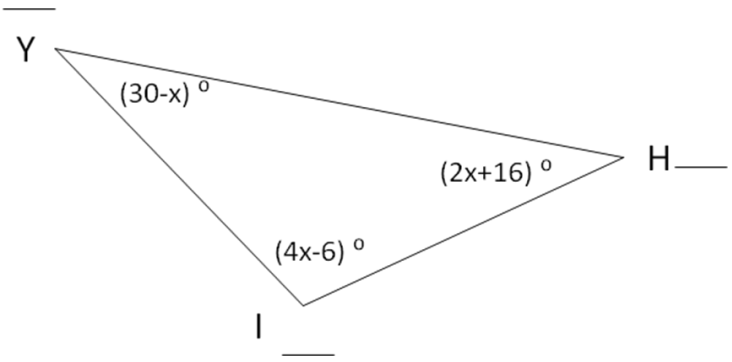


Question: When things go wrong, what can you always count on?

_____	_____	_____	_____		_____	_____	_____	_____	_____	_____	_____
2°	**86°**	**48°**	**89°**		**99°**	**22°**	**50°**	**30°**	**120°**	**60°**	**80°**

Is There a Detective in the House?

1. Given: 7, 9, 13, 14, 16, 24
   Clue 1: The number is less than 5 x 3 but is greater than 5 x 2.
   Clue 2: The number is an even number.
   The number is _____.

2. Given: 12, 13, 14, 15, 16, 17, 18
   Clue 1: The number is an even number.
   Clue 2: The number is not 6 x 2.
   Clue 3: The number is not 4^2.
   Clue 4: The number is not 7 x 2.
   The number is _____.

3. Given: 19, 22, 24, 26, 28, 31, 33, 36
   Clue 1: The sum of the digits of the number is greater than 6.
   Clue 2: The units digit of the number is not 6.
   Clue 3: The number is not 12 + 16.
   The number is _____.

4. Given: 5, 6, 7, 11, 13, 15
   Clue 1: If you add 10 to the number, you get a number which is less than 20.
   Clue 2: If you subtract 5 from the number, you get a number which is not 0.
   Clue 3: The number is not 5 + 1.
   The number is _____.

5. Given: $x^2 = 9x$

Solution: _____, _____
Given: $x \neq 9$
What is it? _____

6. Given: -5, -3, -1, 1, 3, 5.
Clue 1: $3x + 2 < 5$
Clue 2: $x + 4 > 1$
What is it? _____

Where is the Logic?

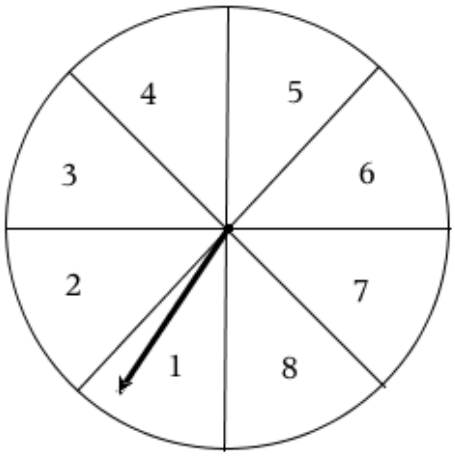
Given: Greta wants to be a veterinarian when she grows up. Greta has a pet dog, guinea pig, cat and lizard. Their names are Edgar, Casper, Thunder, and Rascal. Both Casper and Rascal are older than the guinea pig but younger than the cat. The dog is younger than Capser but older than Edgar.

Task: Use logic to draw conclusions from the clues given above. Draw a line connecting each pet with its name.

Edgar	**Dog**
Casper	**Guinea pig**
Thunder	**Cat**
Rascal	**Lizard**

Doing the Math

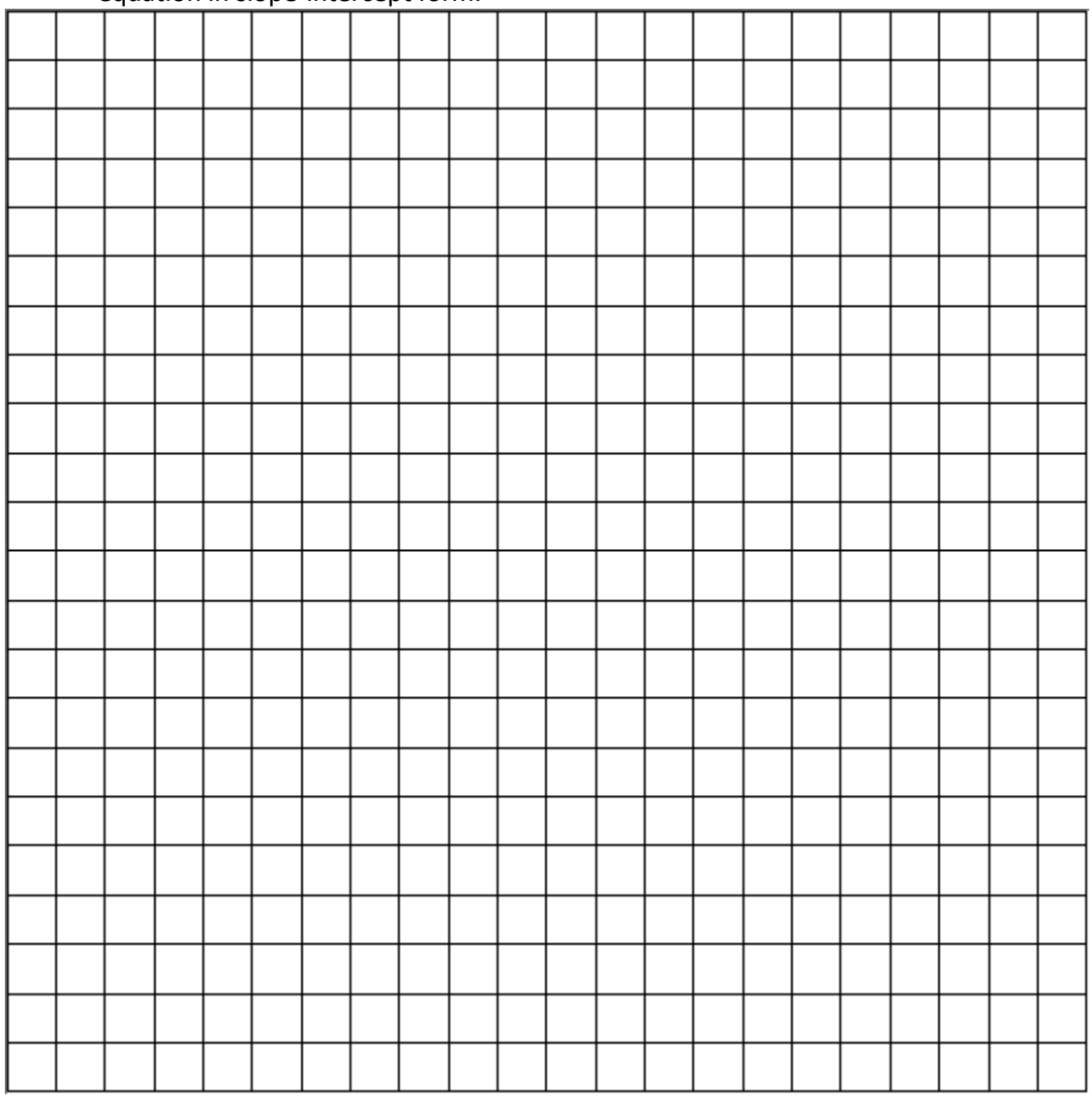
1. What is the probability of spinning a multiple of the number 3 with the spinner shown?



2. Record the shoe size and forearm length of each of your household family members (including you). Let x be the shoe size (U.S. standard) and let y be the forearm length (in inches).

Family Member	Shoe Size , x (U.S. standard)	Forearm length, y (in inches)
1		
2		
3		

a. Draw a scatter plot of the data in the table. Graph paper is on the next page.
b. Draw line of best fit for the data.
c. Choose two points on the line to find an equation of a line of best fit. Write the equation in slope-intercept form.



3. Three basketball players from Roosevelt are practicing free throws during practice. Avana makes 80% of her shots, Rachel makes 56% of her shots, and Orleta makes 72% of her shots.

   a. Draw a tree diagram to represent all of the possible outcomes for the three free-throw shooters on their first free throw.

   b. Find the probability that all three players will make their first shots.

   c. Find the probability that Rachel will make her first shot, but Avana and Orleta will miss their first shots

   d. Find the probability that none of the three players will make their first shots.

   e. Find the probability that all three players will make their first shots.

4. On both grids below, draw a pair of Cartesian coordinate planes such that:
$-4 \leq x \leq 4$ and $-9 \leq y \leq 9$.

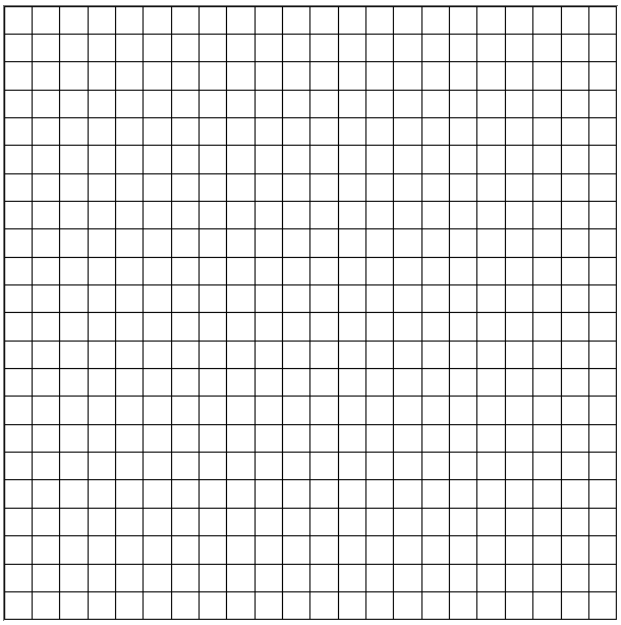
   a. Graph the inequality $y \geq x^2 - 2$ on the first grid on the left. Please shade lightly.

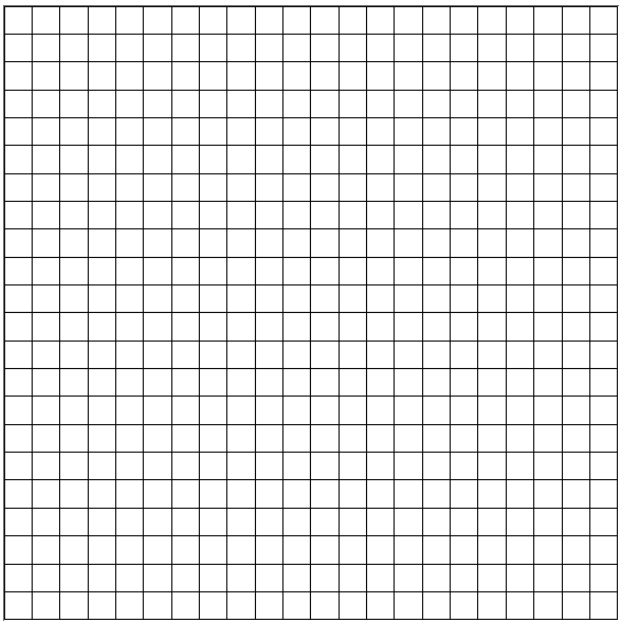
   b. On the same set of axes, graph $y \leq x$. Shade this region lightly.

   c. Darken the overlapping region. Estimate the coordinates of the points where the lines intersect.

   d. Estimate the area of the shaded region.

   e. Suppose we made an adjustment in one of the inequalities, changing $y \leq x$ to $y \geq x$. Make a sketch of the new situation on the second grid on the right. Include the parabola.





The Spoken Word

Solve each equation. Read the question in the box below. To find the answer, write the variable from each problem on the blank space that contains the correct answer. Show all work.

1. $4i - 4 = -10i + 24$

2. $3s + 18 = 2s + 12$

3. $\frac{-L}{3} - 5 = -17$

4. $3e + 6 = 2e + 5$

5. $\frac{n + 2}{5} = -2 + n$

6. $7c + 5 = 8c + 10$

7. $-e + (-7) = 3e + 1$

Question: What is so delicate that when you say its name it is broken?

___	___	___	___	___	___	___
-6	2	36	-2	3	-5	-1

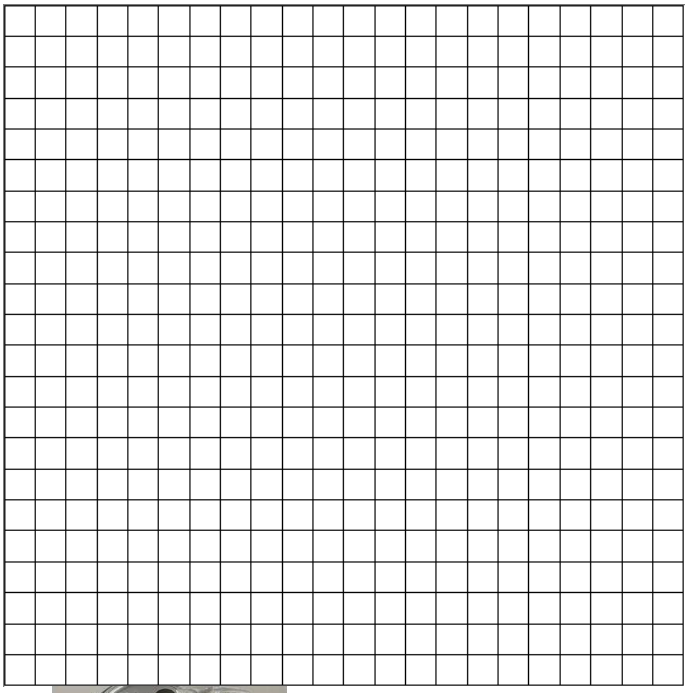
Mobile On The Go….

Mobile On The Go, Inc. produces ***x*** number of cell phones and ***y*** number of accessories. The company's supply of labor and materials is limited. Its production can be described by the following system of inequalities.

$$\begin{cases} 2x + y \geq 5 \\ 2x - y \geq -1 \\ x + y \leq 10 \\ -x + 6y \geq 4 \end{cases}$$

The price at which the company sells its products is represented by $P = 12x + 8y$.
P has its maximum value at a vertex of the region.

a. For which values of x and y is P a maximum?
b. What is this maximum value?
c. Explain how you arrived at your answer.



A Trip to the Movies…

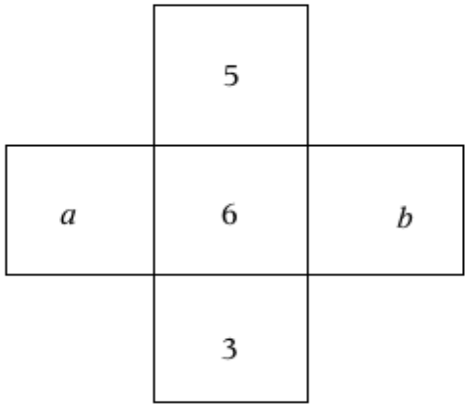
Jenna went to the movie theater and bought one jumbo popcorn and two chocolate bars for $5.00. Manny went to the same movie theater and bought one jumbo popcorn and four chocolate bars for $6.00. How much does one chocolate bar cost?

On the farm…

Farmer Ted weighs 80 chickens. The weights are normally distributed. They have a mean of 3.4 kg with a standard deviation of 0.8 kg. What percent of the rabbits weigh less than 2.6 kg?

Find the sum…

In the figure below, the product of the three numbers in the horizontal row equals the product of the three numbers in the vertical column. If ***a*** and ***b*** are nonzero integers, which of the following could be a value of **a + b** ? (Show all work)



A. 2
B. 15
C. 16
D. 90

Friendship

Directions: Solve each equation Next to each equation are three choices. To solve the riddle below, find the choice that represents the correct answer, and write its letter in the blank above the number for the problem. Show all work.

1.	**x + 9 = 18**	(C) x = 27	(G) x = 9	(T) x = -9
2.	**x – 13 = 16**	(O) x = 29	(K) x = 3	(B) x = 29
3.	**b + (-6) = 6**	(T) b = 12	(J) b = 0	(Z) b = 12
4.	**b + (-12) = 21**	(Q) b = 33	(D) b = 9	(Y) b = 33
5.	**n + (-5) = -23**	(A) n = -18	(F) n = -18	(I) n = 28
6.	**y + (-8) = -12**	(M) y = -20	(L) y = -20	(C) y = -4
7.	**m – 27 = -63**	(W) m = -90	(O) m = -36	(P) m = -36
8.	**x – (-26) = 55**	(T) x = 91	(V) x = 29	(U) x = 91
9.	**y + (-47) = -74**	(B) y = -121	(J) y = -27	(E) y = -27
10.	**-33 = h + 16**	(R) h = -49	(A) h = 49	(L) h = -17
11.	**15 = a + 17**	(C) a = 2	(E) a = -2	(N) a = 2
12.	**5 + n = -13**	(J) n = -8	(K) n = 18	(D) n = -18

Question: What did the rib cage say to the heart?

“____	____	____	____	____	____	____	____	____	____	____	____!”
1	2	3	4	5	6	7	8	9	10	11	12

What Could I Be?

Directions: Find the missing side or hypotenuse for each right triangle. When you have completed a problem, look at the blank lines at the top of the chart. Under each blank there is a number for the problem number and a letter S (for side) or H (for hypotenuse). Write the correct letter in each space. Show all work.

Question: What word looks the same upside down and backwards?

_____	_____	_____	_____	_____
1S	**2S**	**3H**	**4S**	**5H**

No.	Side	Side	Hypotenuse
1		8	10
2	15		25
3	5	12	
4		9	41
5	20	21	

Answer Box:

Side		**Hypotenuse**	
W = 20	C = 36	X = 3	S = 29
T = 100	K = 15	B = 41	D = 78
S = 6	M = 40	I = 13	E = 4

Challenge!

1. Expand $(-2 + 2i)^6$ using De Moivre's Theorem.

2. Solve the equation for x and express the roots in simplest a+bi form: $3x^2 + 5 = 4x$

3. Inga is 6 years older than Henrik and Ludwig is 10 years older than twice Henrik's age. If Ludwig's age is added to 5 years less than twice Inga's age, the result is the same as 7 years more than 5 times Henrik's age. How old is each now?

M&M's and Statistics

Adapted from http://www.sciencebuddies.org/science-fair-projects/project_ideas/Math_p021.shtml

In this experiment you will count the frequency of different colored M&M's in a bag of M&M candies. Will your results show a pattern?

Materials:

- At least 5 packages of plain M&M's
- 2 types of graph paper (see pages 21 and 22)
  - Quadrilateral (http://www.printfreegraphpaper.com/gp/c-i-14.pdf)
  - Polar (http://www.printfreegraphpaper.com/gp/p-i-12-c.pdf)
- Colored pencils or markers

Pre-Activity Questions:

1. How many total M&M's do you predict will be in each bag on average?
2. Do you think the colors in an M&M bag will be in an **equal distribution** (e.g., Will there be an equal number of red, brown, etc. M&M's)? Explain why or why not.
3. What do you think goes into the decision of how many M&M's of each color are in a bag of M&M's? Each bag of plain M&M's should contain the colors red, yellow, orange, green, blue, and brown.
4. If, on average, every bag of M&M's had the same number of each color in every bag, what would the percentages of each color be?

Procedure:

1. In this experiment you will be counting the numbers of different colors of M&M's to calculate frequencies and distributions of the different colors. You will need a data table to keep track of your data:

Number of M&M's of Each Color Counted in Each Package								
Package	1	2	3	4	5	Total	Average	Percent
Brown								
Blue								
Green								
Yellow								
Orange								
Red								
Whole Bag								

2. Open the first bag of M&M's. Count the number of M&M's of each color and write the number in your data table. Don't eat the M&M's before you count them!

3. Repeat for each bag of M&M's. You should sample at least five bags, but you can do as many as you want. The more samples you take, the better your data will be. However, too many samples and you might get a stomach ache!

4. Calculate the total number of M&M's in each bag by adding down each column. Write the answers in the "Whole Bag" box in the bottom row.

5. Calculate the total number of each color in all of the samples by adding across each row. Write the answers in the "TOTAL" column.

6. Calculate the average number of each colored M&M per bag by dividing the total number for each color (calculated in step 5) by the number of samples (equal to the number of bags of M&M's you counted, in this case, 5). Write the answers in the "AVERAGE" column.

7. Calculate the percentage of each colored M&M in the bag from the average data. Do this calculation by dividing the average number of each color by the average number of M&M's in the whole bag and then multiplying your answer by 100. For example, if there are an average of 5 red M&M's in each bag and an average of 50 M&M's in a whole bag, you will divide 5 by 50 (which equals 0.10) and then multiply by 100 (which gives 10%). Write each answer in the "PERCENTAGE" column. (Notice that if you do the same calculation with your totals, you should get 100%)

8. After you have finished your calculations, it is time for you to make graphs to help you analyze your data and detect trends.

9. Now you are ready to make your first graph, the histogram. The **histogram** is a bar graph that will tell you the **frequency** (number of occurrences) of each color of M&M in the bag. It is useful for comparing the absolute frequencies of each group to each of the other groups. You can answer questions like, "In the average bag of M&M's, which color are most of the M&M's (highest frequency)? Which color is the rarest (lowest frequency)? Do any of the colors have the same frequencies?"

10. You will use the average color data for this graph, so make sure you can locate this information in your data table.

11. To make the histogram, label the left side (Y-axis) with a scale representing the numbers of M&M's. The smallest number of the scale (minimum) will be zero and the largest number of the scale (maximum) will be set just above the largest number of M&M's in any group. For example, if the largest number of M&M's counted was 25 brown M&M's, then you should make your scale go up to 30. Make sure that your scale uses the same interval. For example, count by 5s on the Y-axis such that the numbers are 5, 10, 15, etc.

12. Draw a bar for each color that goes up to the number on the scale corresponding to the average number of M&M's counted for that color. Label each bar with the correct color (and even color in the bar with the matching color too). Label the histogram with a title.

13. Now you are ready to make your second graph, the **pie graph**. It will tell you which portion of the whole bag is of each color. It is useful for comparing the relative proportion of each individual group to the whole population. You can answer questions like, "What is the percentage of each color of M&M in the bag? Does any color make up more than half of a bag? More than a third of the bag?"

14. For this graph I recommend that you use polar graph paper. You can also use a protractor and a compass, but I think the polar graph paper is much easier because it divides the circle up for you into discrete units, and you simply count the number of slices for each group and color them in.

15. You will use the percentage data for each color to make this graph, so be sure that you can locate this information in your data table.

16. Make the pie graph color in a slice that is equal to the percentage of the data. For example, if blue M&M's are 15% of a bag, and if your polar graph paper has a bar for every 5 units, then color in three slices for the blue M&M's. It is nice in a pie graph to use a matching color for each section and to provide a color key to label your data. You can even write the percent data inside each slice. You also need to make a title for your graph.

Post-Activity Questions:

1. In the average bag of M&M's, which color are most of the M&M's (highest frequency)?
2. Which color is the rarest (lowest frequency)?
3. Do any of the colors have the same frequencies?
4. What is the percentage of each color of M&M in the bag?
5. Does any color make up more than half of a bag? More than a third of the bag?